Treadwell. According to the translator, W. T. Hall, the original has been so thoroughly revised and so largely rewritten that it is no longer fair to publish the book as a literal translation, and though the general plan has been kept, greater stress has been laid upon the theoretical side of the subject. The introductory chapter deals with such general principles as are usually included in text-books on physical chemistry, viz. electrolytic dissociation, electromotive series, solubility product, mass law, etc., subjects which not only come well within the scope, but are essential to the thorough grasp, of analytical methods.

The book is, in short, not the ordinary type of examination *vade mecum.* It is rather in the nature of a philosophical treatise on analysis in which the subject is treated with the thoroughness demanded by a highly important and dignified branch of chemical science. A special feature of the new edition is the use of ionic equations, which often appear side by side with the more usual form. In this way the student is, without much effort, familiarised with both methods of representing reactions.

(2) The procedure adopted by Dr. Mulliken for the identification of pure organic compounds (in vol. ii.) by means of tables follows very closely that of vol. i. Vol. ii. contains what are termed compounds of Order II., which includes those of the three elements, carbon, hydrogen, and oxygen, of vol. i., with the additional element, nitrogen.

The tables are divided into suborders of colourless and coloured compounds, these again into genera comprising acidic, basic, and neutral compounds, and these again into divisions A and B of solid and liquid species.

An illustrative example of the application of the tables is given, and the author claims that the method of identification is much more rapid than that which would have been required to arrive at an equally certain result by the use of the method of empirical formulæ. This may be true of a substance with no previous history which is thrust into the hands of a chemist for rapid identification. But the writer is by no means convinced that, however valuable the data, the arrangement for research purposes is the most satisfactory that could be devised.

Although it may be true that the scheme of species, genera, suborders, and orders may help one, like a botanical key, to track down an unknown compound more quickly than by means of a combustion, one has to remember that it is rarely that a chemist engaged on research is entirely ignorant of the possible nature of the substance he has obtained. It is not a question of one of a possible 4000 compounds described in these tables, but more probably one of half a dozen.

The molecular formulæ and Richter's lexicon will soon put the chemist on the track of a reference; and if, in addition, he has tables of specific reactions arranged according to molecular formulæ, he will rapidly orient his compound, provided it has been described before.

The present arrangement is too mechanical, and makes too little appeal to the previous sequence of chemical events to be entirely satisfactory. At the same time one would not wish to depreciate the value or trustworthiness of the vast and varied data which Dr. Mulliken has compiled with so much care and discrimination. There are distinct, if restricted, uses for such tables.

It may be added in conclusion that not the least important section in the book is chap. iii., giving a list of reagents, their preparation and uses, which many organic chemists often overlook.

J. B. C.

GARDEN AND FIELD.

(1) *The Standard Cyclopaedia of Horticulture.* By L. H. Bailey. Vol. iii., F—K. Pp. v+1201–1760. Vol. iv., L—O. Pp. v.+1761–2421. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915–16.) Price 25*s.* net each vol.

(2) *The Small Grains.* By M. A. Carleton. Pp. xxxii+699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 7*s.* 6*d.* net.

(1) HORTICULTURE has been well served by its encyclopædists. In this country we possess Nicholson's Dictionary and "The Gardener's Assistant," both admirable works of their kind. But unfortunately, and in spite of the ever-increasing popularity of gardening, no new edition of either of these works has appeared in recent years. One, we know, is under revision, and but for the war a new edition would have appeared before now. No less admirable than these indigenous productions is Bailey's "Standard Cyclopædia of Horticulture," now appearing in a greatly enlarged form. This "cyclopædia" is indispensable to horticulturists if only for the fact that it contains descriptions of the many new garden plants which are of recent introduction, particularly from China. Although this country led the way in the systematic horticultural exploration of that wonderful country, America has made notable contributions thereto, and the many introductions due to Wilson, Forrest, Purdom, Ward, and Farrer are now coming into general cultivation both in the States and here. Not a few of these acquisitions are described in the pages of Dr. Bailey's work.

As is to be expected from the provenance of this work, the sections treating of tools and machinery are particularly well done, the article on machinery and implements extending over upwards of twenty closely printed pages, and beginning with the just claim that "the American is known by his tools and machinery."

Of great interest to British horticulturists also is the comprehensive account given of horticulture in the North American States, to which more than 100 pages of vol. iv. are devoted. The

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exporting British horticulturists—and we are too apt to ignore that there is a large horticultural export trade from this country to the States—will derive much valuable information from a study of this section of the work. We commend the account given of the horticultural experiment stations in the various States to the particular attention of those whose business it is to give State encouragement to horticultural research in this country.

The "Cyclopædia" is well and copiously illustrated; the black-and-white figures are excellent. The coloured plates, however, are, as is so often the case, of unequal merit.

Taken as a whole, this American encyclopædia is a great monument to Dr. Bailey's energy and knowledge, and should find its place on the shelves and in the hands of all British gardeners.

(2) In "Small Grains," by Prof. Mark A. Carleton, a comprehensive account is given of the cereal crops—wheat, oats, rye, and barley—and of buckwheat and rice. A mass of useful information is contained in the 700 pages which constitute the book, and it is no doubt useful to the student of "agronomy" to have access to this information within the covers of one book. Nevertheless, it seems to us that a student who mastered the multifarious contents of this volume would do so at the risk of ruin to his mental digestion. In any case, he would deserve the encomium lavished by Goldsmith on the village schoolmaster:—

> . . . and still the wonder grew
> That one small head could carry all he knew.

The English student, at all events, must look on this book rather as a compendious work of reference than as a text-book, and used in this way it will no doubt prove of considerable value.

Particularly good is the account of the different kinds of wheat—common, club wheat, poulard or rivet, durum, einkorn, emmer, spelt, and Polish, and of the chief varieties grown in America and other parts of the world.

With so vast a subject it is not to be wondered at that the discussion of many of its aspects is brief; but to an English reader it appears strange that the author has not found room for the inclusion of Biffen's work on breeding (for although reference is made to that author's determination of dominant characters, nothing is said of his classical experiments in the combination of characters). Nor, though considerable attention is devoted to manuring, do we find, so far as we have been able to discover, any account of the pioneer and fundamental work of Rothamsted.

Although Prof. Carleton's work is designed primarily for the American agronomist, it is one which the scientific agriculturists of this country will be glad to have if only for the somewhat remarkable manner in which the author contrives to give a bird's-eye view of the vast area and diverse conditions over and under which the "small grains" are cultivated in the United States.

OUR BOOKSHELF.

Fatigue Study: The Elimination of Humanity's Greatest Unnecessary Waste: A First Step in Motion Study. By Frank B. Gilbreth and Dr. Lillian M. Gilbreth. Pp. 159. (London: George Routledge and Sons, Ltd., 1916.) Price 6*s*. net.

The main thesis of the authors of this book is that much of the fatigue occurring among industrial workers is unnecessary, and is caused by the carrying out of the work under conditions which involve excessive and avoidable expenditure of energy. The methods suggested for the elimination of unnecessary fatigue consist for the most part of various mechanical devices. One of these consists in the provision of high chairs so that the workers can sit to their work instead of having to stand. Another suggestion is the use of chairs provided with springs which exclude vibration from the floors of buildings in which high-speed machinery is used. Considerable attention is directed to the value of organisation in the placing of his material in the most convenient position for handling by the worker, to the importance of suitable lighting, and to the desirability of frequent rest intervals during the day's work. A useful point which is brought out is that the value of rest periods is greatly enhanced by the provision of an adequate supply of rest chairs. The authors find that the application of these methods produces a striking improvement, both in the physical condition of the workers and in the efficiency of their work.

Farm Spies: How the Boys Investigated Field Crop Insects. By Prof. A. F. Conradi and W. A. Thomas. Pp. xi+165. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 3*s*. net.

This is a collection of brightly written, well-illustrated "story-articles" on various common injurious insects of North America, designed to catch the attention and enlist the sympathies of "boys and girls and those persons who know nothing about insects and how to fight them." Among the pests described are the cotton boll-weevil and root-louse, chinch-bugs (an American "bug" that is really a bug), grasshoppers, and the black corn weevil. The life-histories and habits of the insects are drawn out by conversations between farmers and entomologists, and the farmers' boys are naturally enlisted in the work of destroying the ravagers of crops. Points in the breeding and feeding habits that bear on farm practice are often cleverly emphasised, and some of our British students might be well occupied in compiling for the Home Country a somewhat similar work. "Nearly every incident mentioned has at some time or other come within the experience of the authors," we are told in the preface. The qualification is satisfying when we read how "Dr. Science, walking across a field, heard a vetch plant and a bacterium talking together," how he asked "Would it be possible for you two to get together and trade?" and how the vetch

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